

CLAIMS

What is claimed is:

1. A cassette for use in an electrophoresis apparatus, the cassette comprising:

at least two liquid reservoirs formed in the cassette spaced apart from one another, each reservoir being adapted to receive a liquid;

a substrate support located between the liquid reservoirs;

at least one port in fluid communication with at least one of the reservoirs and extending to an external surface of the cassette;

at least one electrode located within each liquid reservoir; and

at least one electrical contact located on an external surface of the cassette and electrically connected to the at least one electrode so as to permit current to pass between the electrical contact and the electrode.

2. The cassette according to claim 1, further comprising an electrophoretic substrate disposed on the substrate support, the substrate including at least two opposed ends, each end extending into one of the liquid reservoirs.

3. The cassette according to claim 1, wherein there are four liquid reservoirs formed in the cassette; wherein there are four electrodes and four contacts, one electrode in each reservoir, each electrode being substantially orthogonal to the adjacent electrodes and electrically connected to a separate electrical contact located on an external surface; and wherein there are at least two ports for supplying and removing liquid and at least one port for venting gas, each liquid port providing fluid communication between an associated reservoir or an associated pair of non-adjacent reservoirs and an external surface of the cassette, the vent port(s) providing fluid communication between at least one reservoir and an external surface of the cassette for passage of gas.

4. The cassette according to claim 1, wherein there are at least two ports formed in the upper portion, each port extending between a liquid reservoir or pair of non-adjacent liquid reservoirs and an external surface of the cassette and adapted to permit flow of gas between outside of the cassette and the liquid reservoir or pair of non-adjacent liquid reservoirs; wherein there are at least two ports formed in the lower portion, each port extending between a

reservoir or pair of non-adjacent liquid reservoirs and an external surface of the cassette and adapted to permit flow of liquid between outside of the cassette and the liquid reservoir or pair of non-adjacent liquid reservoirs; and wherein there are at least two electrical contacts formed on the lower portion, each contact being electrically connected to the electrodes in a separate liquid reservoir or pair of non-adjacent liquid reservoirs.

5. The cassette according to claim 4, wherein the upper portion is spaced apart from the substrate support so as to define a substrate reservoir between the liquid reservoirs, which substrate reservoir is adapted to receive fluid; and wherein there is an additional port formed in the upper portion which permits passage of fluid into and out of the substrate reservoir.

6. The cassette according to claim 5, wherein the port formed in the upper portion permits flow of gas; and wherein there is a port formed in the substrate support which provides fluid communication between the substrate reservoir and an external surface of the cassette for passage of liquid out of the substrate reservoir.

7. The cassette according to claim 1, wherein at least part of the upper portion is movable with respect to the substrate support when the upper portion is engaged with the lower portion.

8. The cassette according to claim 7, wherein the part of the upper portion that is movable is a cover that spans over at least a portion of the substrate support; and wherein the movability of the cover is provided by a resilient member located between a peripheral edge of the cover and an edge of the upper portion, the resilient member optionally biasing the cover away from the substrate support.

9. The cassette according to claim 7, wherein the entire upper portion is movable with respect to the substrate support when the upper portion is engaged with the lower portion.

10. The cassette according to claim 9, wherein the movability is provided by a flexible gasket mounted between the upper portion and the lower portion.

11. The cassette according to claim 9, wherein the movability is provided by a spring mounted between the upper portion and the lower portion.

12. The cassette according to claim 1, wherein the liquid reservoirs are formed from at least one gasket located between the upper and lower portions, the gasket having two spaced apart cut-outs, each cut-out defining at least a portion of a reservoir.

13. The cassette according to claim 12, wherein the at least one gasket has a third cut-out located above the substrate support and which cut-out defines a substrate reservoir adapted to receive a fluid.

14. The cassette according to claim 12, wherein the at least one gasket is attached to a section of the upper portion.

15. The cassette according to claim 1, further comprising a heat sink attached to the substrate support for providing heat transfer from the substrate support.

16. The cassette according to claim 3, wherein the liquid ports and the at least one vent port all extend to one side or bottom surface of the lower portion, and wherein the electrical contacts are located at the same side or bottom surface of the lower portion.

17. The cassette according to claim 4, wherein the liquid ports and the at least one vent port all extend to one side or bottom surface of the lower portion; and wherein the electrical contacts are located at the same side or bottom surface of the lower portion.

18. The cassette according to claim 1, further comprising a porous layer disposed on the substrate support and extending into the liquid reservoirs.

19. The cassette according to claim 1, wherein the substrate support is removably attached to the body.

20. The cassette according to claim 1, wherein a removable attachment permits the substrate support to be slid laterally into the body.

21. A cassette for use in an electrophoresis apparatus, the cassette comprising:

a cover;

a body removably engageable to the cover;

at least two liquid reservoirs formed in the cassette between the cover and the body, the reservoirs being spaced apart from one another and adapted to receive a liquid;

a substrate support located in the body between the liquid reservoirs;

at least two liquid ports formed in the body, each liquid port extending between an associated liquid reservoir or pair of non-adjacent liquid reservoirs and an external surface of the body for channeling liquid between the reservoir or pair of non-adjacent reservoirs and the outside of the cassette;

at least two vent ports formed in the cover, each vent port extending between an associated liquid reservoir or pair of non-adjacent liquid reservoirs and an external surface of the cassette for channeling gas between the reservoir or pair of non-adjacent reservoirs and the outside of the cassette;

at least one electrode located within each liquid reservoir; and

at least one electrical contact located on an external surface of the cassette, the contact being electrically connected to the electrodes so as to permit current to pass between the electrical contact and the electrodes.

22. The cassette according to claim 21, further comprising an electrophoretic substrate disposed on the substrate support, the substrate including at least two opposed ends, each end extending into one of the liquid reservoirs.

23. The cassette according to claim 21, wherein there are four liquid reservoirs formed in the cassette, each reservoir located substantially orthogonal to the adjacent reservoirs, each reservoir including a liquid port, a vent port and an electrode, each electrode having an associated electrical contact.

24. The cassette according to claim 23, wherein the liquid ports and the vent ports extend to one side or bottom surface of the body; and wherein the electrical contacts are located at the same side or bottom surface of the body.

25. The cassette according to claim 21, wherein a portion of the cover extends over and is spaced apart from the substrate support so as to define a substrate reservoir between the liquid reservoirs, the cassette further comprising a substrate liquid port formed in the body and a substrate vent port formed in the cover, the substrate liquid and vent ports extending between the substrate reservoir and an external surface of the cassette.

26. The cassette according to claim 25, wherein the liquid ports and the vent ports extend to one side or bottom surface of the body; and wherein the at least one electrical contact is located at the same side or bottom surface of the body.

27. The cassette according to claim 21, wherein at least a portion of the cover is mounted so as to be moveable with respect to the substrate support when the cover is attached to the body, the mounting optionally biasing the movable portion away from the substrate support.

28. The cassette according to claim 27, wherein the mounting is a flexible gasket between the movable portion of the cover and the remainder of the cover.

29. The cassette according to claim 27, wherein the mounting is a spring disposed between the cover and the body.

30. The cassette according to claim 21, wherein the liquid reservoirs are formed from at least one gasket located between the cover and body, the gasket having two spaced apart cut-outs, each cut-out defining at least a portion of a reservoir.

31. The cassette according to claim 21, further comprising a heat sink attached to the substrate support for transferring heat from the substrate support.

32. The cassette according to claim 21, further comprising a porous layer disposed on the substrate support and extending into the reservoirs.

33. The cassette according to claim 21, wherein the substrate support is removably attached to the body.

34. The cassette according to claim 21, wherein the removable attachment permits the substrate support to be slid laterally into the body.

35. A method for performing electrophoresis comprising the steps of: providing a cassette having a cover and a body, the cassette including first and second liquid reservoirs located between the cover and body and spaced apart from one another by a substrate support, a substrate disposed on the support and having opposed ends located within each liquid reservoir, and electrodes located within each reservoir;

providing an electrophoretic apparatus having a docking station for receiving a cassette, a liquid buffer source, a waste container and a power source;

docking the cassette in the docking station of the apparatus such that the liquid buffer source and the waste source are in fluid communication with the

reservoirs, and that the power source is in electrical communication with the electrodes;

placing a sample to be tested onto the substrate;

supplying buffer from the apparatus to the first and second reservoirs to fill the reservoirs to a height above the ends of the substrate located in the reservoirs;

saturating the substrate;

supplying power from the apparatus to the electrodes in the reservoirs to produce separation;

removing power from the electrodes;

channeling the used buffer from the reservoirs to the waste storage in the apparatus; and

analyzing the substrate separation.

36. A method for performing two dimensional electrophoresis comprising the steps of:

providing a cassette having a cover and a body, the cassette including a pair of spaced apart first dimension liquid reservoirs and a pair of spaced apart second dimension liquid reservoirs, the reservoir pairs being located between the cover and body and orthogonal to one another, a substrate support disposed between the liquid reservoirs in each pair, a substrate located on the support, the substrate having four sides, one side located within each liquid reservoir, and electrodes located within each reservoir;

providing an electrophoresis apparatus having a docking station for receiving a cassette, at least one liquid buffer source, a waste container and a power source;

docking the cassette in docking station of the apparatus such that the liquid buffer source and the waste source are in fluid communication with the reservoirs, and that the power source is in electrical communication with the electrodes;

placing a sample to be tested onto the substrate;

supplying a first buffer from the apparatus to the first dimension liquid reservoirs to fill the reservoirs to a height above the ends of the substrate located in the reservoirs;

saturating the substrate with the first buffer;

supplying power from the apparatus to the electrodes in the first dimension liquid reservoirs to produce first dimension separation;

removing power from the electrodes;

channeling the used buffer from the first dimension liquid reservoirs to the waste storage in the apparatus;

supplying a second buffer from the apparatus to the second dimension liquid reservoirs to fill the reservoirs to a height above the ends of the substrate located in the reservoirs;

saturating the substrate with the second buffer;

supplying power from the apparatus to the electrodes in the second dimension liquid reservoirs to produce second dimension separation;

removing power from the electrodes;

channeling the used buffer from the second dimension liquid reservoirs to the waste storage in the apparatus; and

analyzing the substrate separation.

37. A method for performing electrophoresis comprising the steps of:

providing a cassette having a conveyance system including a substrate support that extends from a first point to a second point, first and second liquid reservoirs located along the conveyance system between the first and second points, the reservoirs being spaced apart from one another, a plurality of substrates spaced apart from one another on the substrate support, each substrate having opposed ends, and electrodes located within each reservoir;

providing a liquid buffer source, a waste container and a power source;

placing a sample to be tested onto the substrate;

supplying buffer from the liquid buffer source to the first and second reservoirs to fill the reservoirs to a first height;

conveying the substrate support;

causing each substrate on the substrate support to pass into the first reservoir below the first height of liquid buffer to saturate the substrate with buffer;

causing the substrate to pass out of the first reservoir;

supplying power to the electrodes in the first and second reservoirs when the substrate is between the first and second reservoirs and while an end of the substrate is still within each reservoir;

removing power from the electrodes;

channeling the used buffer from the reservoirs to the waste storage in the apparatus; and

conveying the substrate to a location for post-separation treatment;

analyzing the substrate separation.

38. A method for performing two dimensional electrophoresis comprising the steps of:

providing a cassette having a cover and a body, the cassette including a pair of spaced apart liquid reservoirs located between the cover and body, a substrate support disposed between the liquid reservoirs, a substrate located on the support, the substrate having four sides, with two of the four sides being located within the liquid reservoirs, and electrodes located within each reservoir;

providing an electrophoresis apparatus having a docking station for receiving a cassette, at least one liquid buffer source, a waste container and a power source;

docking the cassette in docking station of the apparatus such that the liquid buffer source and the waste source are in fluid communication with the reservoirs, and that the power source is in electrical communication with the electrodes;

placing a sample to be tested onto the substrate;

supplying a first buffer from the apparatus to the liquid reservoirs to fill the reservoirs to a height above the ends of the substrate located in the reservoirs;

saturating the substrate with the first buffer;

supplying power from the apparatus to the electrodes to produce first dimension separation;

removing power from the electrodes;

disengaging the substrate from the cassette, rotating the substrate 90 degrees and replacing the substrate in the cassette such that the remaining two sides are in the reservoirs;

supplying power from the apparatus to the electrodes to produce second dimension separation;

removing power from the electrodes;

channeling the used buffer from the liquid reservoirs to the waste storage in the apparatus; and

analyzing the substrate separation.

39. An electrophoresis apparatus comprising:

a docking station for receiving a cassette;

at least one electrical contact located at the docking station, the electrical contact being electrically connectable to a power source for supplying current to the contact;

at least one buffer source;

a waste storage container;

at least one gas source;

a liquid manifold including at least one dispenser located at the docking station, a plurality of conduits for conveying liquid from the buffer source to the dispenser and for conveying waste from the docking station to the waste storage container, and at least one valve for controlling flow through the dispenser;

a gas manifold including at least one dispenser at the docking station, at least one conduit for conveying gas between the gas source and the dispenser, and at least one valve for controlling flow through the dispenser; and

a controller for controlling operation of the valves.

40. An electrophoresis apparatus comprising:

a docking station for receiving a cassette;

at least one electrical contact located at the docking station, the electrical contact being electrically connectable to a power source for supplying current to the contact;

at least one buffer source;

a waste storage container;

a post separation solution source;

at least one gas source;

a liquid manifold including a plurality of dispensers at the docking station, a set of first conduits connected to the buffer source, the waste storage container and the post-separation solution source;

a first valve connected to each first conduit;

a set of second conduits connected to each valve;

a second valve connected to each second conduit;

a set of third conduits, each third conduit connecting a second valve to a dispenser;

a gas manifold including at least one dispenser at the docking station, at least one conduit for conveying gas between the gas source and the dispenser, and at least one valve for controlling flow through the dispenser; and

a controller for controlling operation of the valves.

41. An electrophoresis apparatus comprising:

at least two liquid reservoirs spaced apart from one another;

a conveyance system for receiving a series of substrates, the conveyance system including a substrate support, the conveyance system adapted to transport the substrate support through at least one liquid reservoir;

at least one electrode located in each liquid reservoir and electrically connectable to a power source for supplying current to the electrode; and

at least one conduit for supplying buffer to at least one of the reservoirs.

42. An electrophoresis substrate comprising a substrate and an identification device associated with the substrate for providing information pertaining to an electrophoresis process.

43. An electrophoresis substrate having at least four edges and at least one cutout formed through the substrate.

44. An electrophoresis substrate having a plurality of edges and at least one notch formed in at least one edge.

45. An electrophoresis substrate comprising:

a substrate; and

a backing including a thermal conductor.